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50. Internationales Wissenschaftliches Kolloquium
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E.Ševtšenko / T.Karaulova / R.Kyttner

Intelligent Decision Support System as the Tool for Optimisation of Engineering and Production Planning for Collaborative SME -s

ABSTRACT

The scope of this research work will include development of intelligent decision support system for the Network of Collaborative enterprises, which will provide decision support for the Network participants and is based on the use of strategic (aggregate) planning model for creating the manufacturing management decisions. Paper includes model with tasks the DSS must be able to optimise in the network of collaborative enterprises. The main aim of this paper is to make clear what task will the IDSS be able to solve.

INTRODUCTION

Many companies are applying groupware technology to increase business-to-business collaborations (e.g. collaborations among the company, its customers, and its suppliers) over intranets and extranets. Another development in the information systems area is the growing importance of enterprise resources planning (ERP) systems [1]. ERP has focused primarily on processing of transaction data resulting in the creation of the extensive, organizational databases of an organization. The extensive databases created by the ERP system provide the platform for decision support, data warehousing, data mining, and executive support systems.

The majority of DSS in use today [2] are developed to generate and evaluate decision alternatives via 'what-if' analysis and 'goal-seeking' analysis in the design and choice stages.

- *Accounting* models facilitate planning by calculating the consequences of planned actions on estimate-of-income statements, balance sheets and other financial statements.
- *Representational* models estimate the future consequences of actions on the basis of partially non-definitional models, including all simulation models.
- *Optimization* models generate the optimal solutions.
- *Suggestion* models lead to a specific suggested decision for a fairly structured task. Such systems perform mechanical calculations and leave little role for managerial judgment.

Enterprise Resource Planning (ERP) and Intelligent Decision Support Systems (IDSS) have independently evolved and prospered in the marketplace. These include [3] Business Intelligence, Customer Intelligence, Supply Chain Intelligence, and Business Analytics. At the same time, IDSS are taking advantage of the data resident in ERP systems. This emerging convergence has motivated us to look at the integration of ERP and IDSS. The integration of ERP and IDSS provides firms with a number of advantages. They are able to improve the quality and visibility of their information, and they can form a solid foundation from which they can achieve multi-enterprise collaboration.

Traditionally, ERP systems have provided firms with limited analytical capabilities, but have made up for this limitation via strong data storage, access, scrubbing, and integration capabilities. Conversely, IDSS have provided firms with strong data transformation, discovery, and knowledge-gaining capabilities, but have not been able to provide this functionality at an enterprise-wide level. The capabilities provided by each of these systems, combine to increase Intelligence [4]. Thus, the integration of ERP and IDSS can play a significant role in allowing firms to maximise the potential of their Intelligence Density, thereby taking care of their internal environments. In addition, by using integrated ERP and IDSS can achieve multi-enterprise collaboration by reaching beyond the confines of their boundaries and forming valued relationships with all their partners.

COOPERATIVE NETWORKS

The advanced of technology forced the enterprises to have a fresh look towards their strategies to survive, sustain and succeed in the ever-changing business scenario. Globalisation of the businesses and collaboration across the value chain has become the order of the day [5].

The past few years have shown an increasing interest of companies in a close cooperation with other partners. Under pressure from global competition, small and medium-sized companies have particularly been determined to set up cooperation networks [6]. The competition in business has changed from “company versus company ” to “business network versus business network” [7]. The idea of collaboration network foundation was researched extensively, but objective of this work is to concentrate on development of an intelligent decision support system for production enterprises of collaboration network.

A manufacturing decision support system is a strategic and tactical tool capable of supporting a variety of users in making informed decisions. Information from this system will be used to support both the external and the internal objectives of the corporation. With this objective, it must allow users to analyse the past, manage the present, and investigate future options. The

DSS should accommodate data from several business functions, such as engineering, planning, operations, and finance. The volume and diversity of this data do not determine its usefulness. The effectiveness of a manufacturing IDSS is dependent on the alignment of two conditions – the ability to collect the required data from the business functions and the conversion of that data into useful information.

INTEGRATION OF ERP & DSS

While ERP systems solved the problem of centralising disparate data and streamlining business processes, over time they made firms rich in data. This placed demands on the field of DSS to introduce applications that could integrate with ERP systems. This integration was to serve the purpose of taking this data, turning it into information, and eventually creating knowledge. This brought about the introduction of Business Intelligence (BI) and Analytic Applications in the 1990s. These applications enabled decision makers to obtain enterprise-wide data more easily. Among the many possible sources of data for these Business Intelligence and analytic solutions are ERP systems.

The integration of ERP and IDSS brings about a number of significant benefits. These include the ability to improve the quality and visibility of information, increase Intelligence Density, and achieve multi-enterprise collaboration. [3]. Intelligence Density defines the value of integration ERP and DSS. By using this Intelligence Density conception, we can understand the relative value of various DSS tools and technologies and their integration with ERP systems, in order to provide better decision support for decision makers.

A firm can integrate an ERP system with IDSS in one of several ways:

- extend the functionality of current DSS so that they can easily access the data stored in an ERP system;
- integrate existing DSS that currently sit on top of a firms' ERP system;
- integrate existing DSS that currently sit on top of a firms' ERP system across multiple firms;
- build a single, flexible, and comprehensive DSS that sits on top of an ERP system.

Practically, it is important to take into account that these ERP and IDSS integration options may be achieved via an emerging class of integration technologies called Enterprise Application Integration (EAI) [8]. The other way integration ERP and IDSS is using integrated agents. Multi-enterprise collaboration framework by using agents is introduced in figure 1.

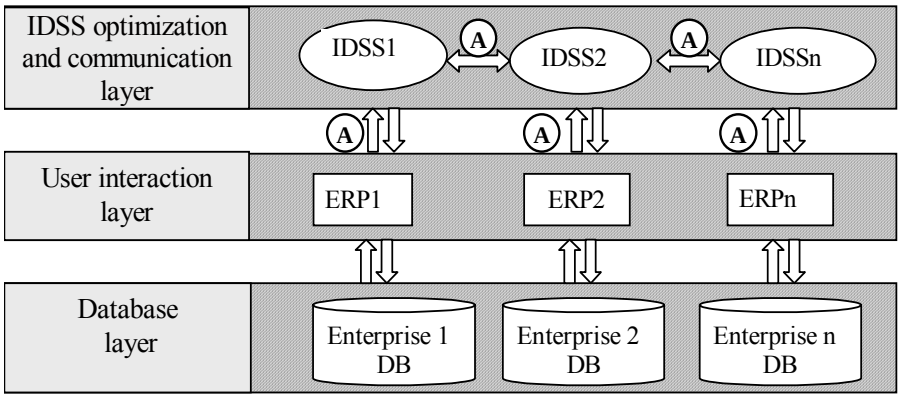

Figure 1. Multi-enterprise collaboration

To support a set of decision makers working together as a group, group IDSS have special technological requirements of hardware, software, people and procedures. Each member of the group usually has a personal computer, which is linked to the personal computers of other group members, and to one or more large public viewing screens, so that each member can see the inputs of other members or let other members see their work. Group IDSS software also need special functional capabilities, in addition to the capabilities of single user DSS software, such as anonymous input of the user's ideas, listing group members' ideas, voting and ranking decision alternatives [1]. The people component of group DSS should include a group facilitator, who leads the session by serving as the interface between the group and the computer systems.

The proposal of a Multi-Enterprise Collaborative ERP-IDSS conceptual framework allowed us to portray the existing range of quality solutions. These system framework proposals introduced a fresh perspective on the integration of ERP and IDSS, and their role in supporting firms in their quest to obtain and maintain valued relationships with their partners.

IDSS have the ability to take the integrated data stored within this database and transform it, through various analysis techniques. ERP systems are able to achieve integration by bringing together data from different sources within the firm. This may include disparate databases that exist across different functional units, thus helping the firm to gain a more complete and realistic picture of all the data they hold. ERP systems have traditionally not been able to provide satisfactory support for transforming data, and enabling decision makers to discover and learn, ultimately turning this data into knowledge. This is where DSS have been able to give strong support.

The integration of ERP and DSS provides firms with a number of advantages. They can form a solid foundation from which they can achieve multi-enterprise collaboration.

MODEL OF INTELLIGENT DECISION-SUPPORT SYSTEM

Current analytical tools support the needs of production enterprises in collaborative network. Among those needs are the abilities to:

- import/export data from databases of ERP systems used on enterprises.
- find the most profitable solutions for profit maximization taking into account existing constraints.
- support management of enterprises throws the strategic decisions making process, before contractual agreements between partner enterprises.

Current models of collaborative enterprises do not include Intelligent System to provide strategic decisions making support for production enterprises but there are interesting software packages for the support of collaborative work. It seems to be useful if Intelligent System support people collaboration in the way of decision support, and automated features will be used for optimisation of commonly used processes (production plan optimisation and etc.). The research task is to work out the tool, which will support the collaborative enterprises though the strategic decision making process. The intelligent decision support system is analytical unit in the network of collaborative enterprises. It is able to support management decision by making clear binding constraints, optimise production plans, and to optimise the work of whole collaborative network.

It is planned that intelligent system will be able to simulate all feasible solutions in order to find the most optimal one. The intelligent system is useful due to it ability to download required information from ERP systems of participants automatically through the protected virtual channels (VPN). In this case the information is secure and shared accordingly with the internally achieved agreements of collaborative network. The lists of the products and components and work centres used, prices, delivery terms and other important information will be shared and analysed by intelligent system. For the given product mix the intelligent system will be able to:

- Demand feasibility estimations;
- Bottleneck recognition;
- Analysis of constraints.

In this research work will be described intelligent solution which will outsource part of the product to sub contractual enterprise, in order to eliminate binding constraints for profit maximisation.

The intelligent decision support system is a necessary tool in collaborative network of production enterprises. Intelligent system aim is to analyse different possibilities of production in collaborative network of production enterprises.

On the IDEF0 diagram (Figure 2) could be seen the process of production network management. It is represented as the system with inputs and outputs. As we can see the IDSS system is working together with the ERP network of enterprises, every system is responsible for own tasks.

As we can see the IDSS is located on intermediate level and its task to provide optimised inputs into the ERP system processor.

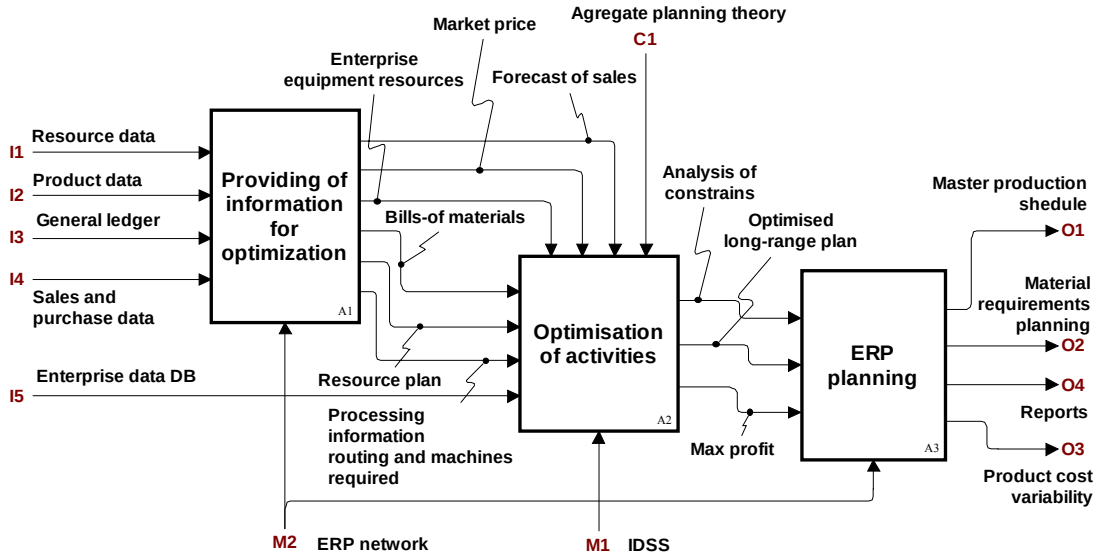

Figure 2. IDEF0 diagram of production network management process

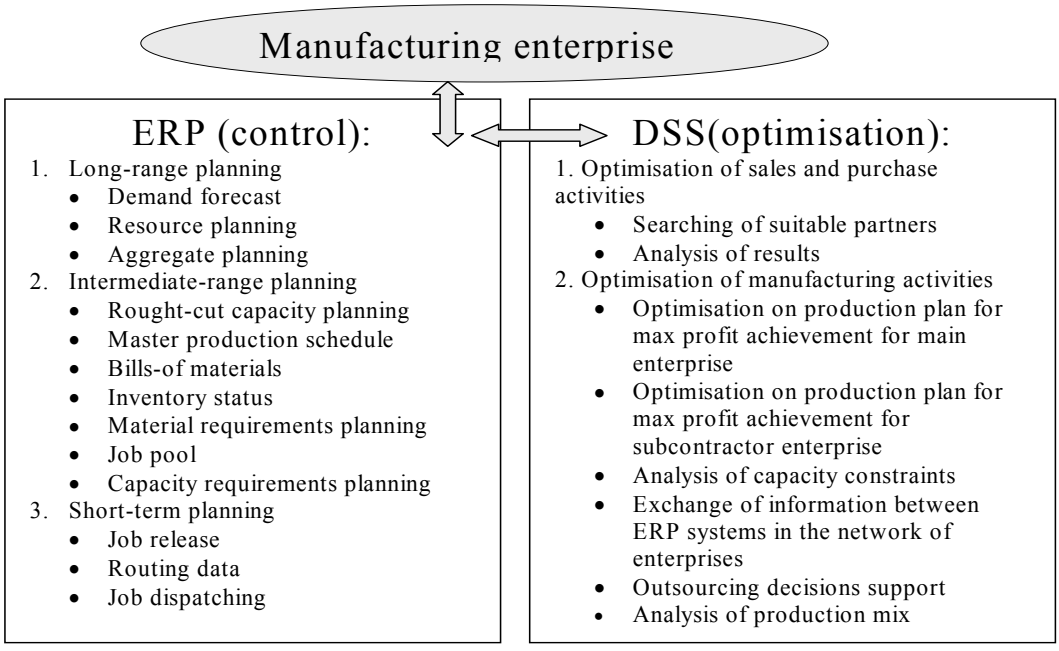

Figure 3. Tasks of ERP and IDSS systems are able to solve

Lets have a look at the main functionality of the model. The working data of enterprise is inserted in the ERP system of enterprise. Different departments are working with required modules, and as the result the integrated data is inserted in the ERP systems of enterprise network. In Figure 3 are enumerated main functions, performed

It is possible to look deeper into the system in order to study the main functions performed by IDSS (see Figure 4).

Providing of information for optimisation

The first step is the "Providing of information for optimisation". The optimisation of activities could be made on the enterprise level, or network level. In the first case the IDSS system just perform the activities of the enterprise and communicate only with ERP system of enterprise, in second case the IDSS is communicate with ERP network. ERP system is the integrated enterprise data system. ERP software is divided into functional areas of operation; each functional area consists of a variety of business processes. The main, common functional areas of operation in most companies would include [9]: Marketing and Sales; Production and Operations (Materials Management, Inventory, etc.); Accounting and Finance, Human Resources. Since all functional areas are interdependent, this separation was not a valid representation of a business' activities and the divisions among the many information systems created artificial barriers that needed to be overcome.

All information required for optimisation activities of IDSS could be found in the related tables of ERP system database. The product related data is located in the manufacturing module. Sales and purchase data in the Sales and purchases module. Inventory data could be found in the Inventory module and all ledger data could be found in the general ledger module. The structures of ERP systems are different, but the required data could be taken out by ERP system specialized output agents which are able to work with specified ERP system. The output agent is the software unit, which is able to select and transfer particular data to the IDSS system. The principle of work of output agents is the same, the only difference that every output agent is responsible for different kind of information: BOM data; resource plan; processing information, routing and machines required; market price; enterprise equipment resources; sales forecast.

Optimisation of activities

After all required data is transferred to the IDSS, the next stage will be "Optimisation of activities". Optimisation is based on the "aggregate planning theory". The main idea is to support in decision making, due the max of profit in the conditions of real constraints. The IDSS outputs are: analysis of constraints; optimised production plan and maximum possible profit. The outputs of the IDSS will be transferred to the ERP network by using input agents.

The structure of the input agent is similar to the structure of output agents. Also different input agent must be used to transfer of information to different ERP system.

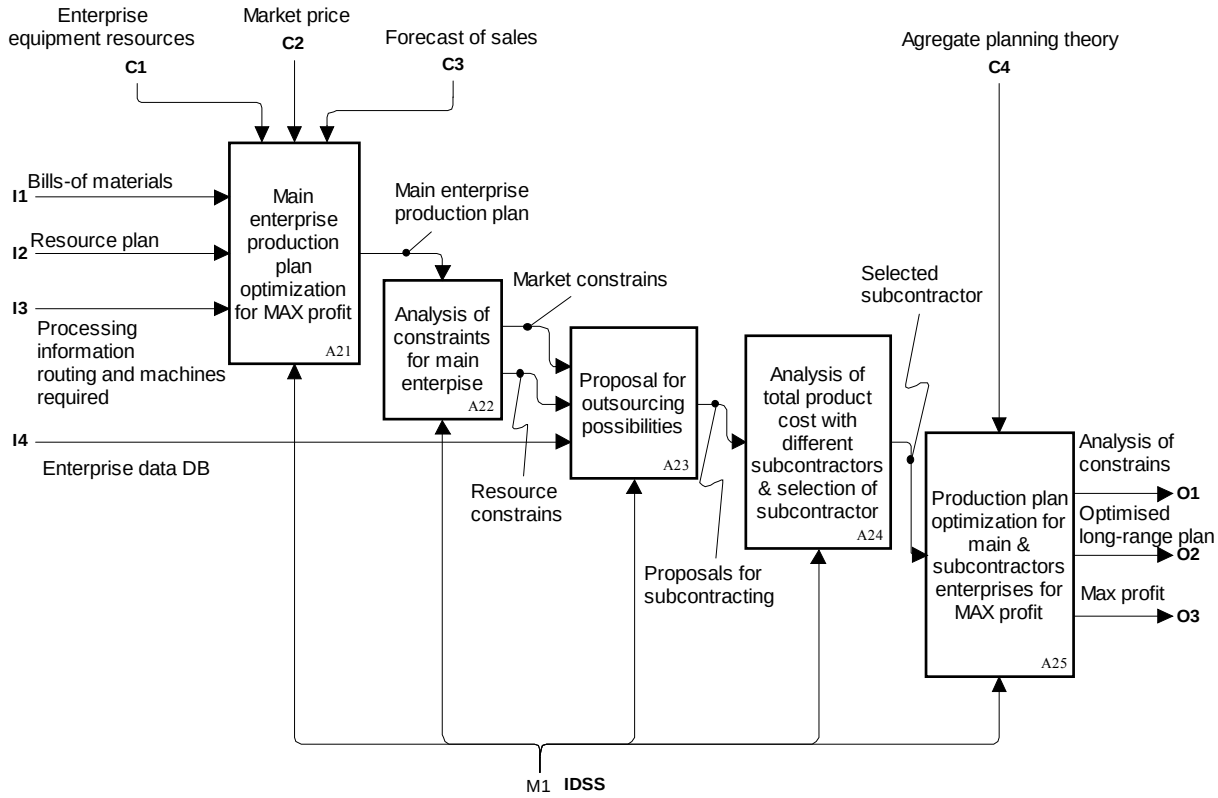

Figure 4. Maim functions of IDSS system (second level of IEF0 diagram)

ERP planning.

After optimised data is received by ERP system the standard processing of the information could be started by ERP processor. The outputs will be: long-range plan, intermediate plan and short-term plan.

ERP software eliminates the barriers to sharing data and processes that occur when companies design and implement information systems for a single function or activity. ERP software coordinates the entire business process, and stores all the captured data in a common database, accessible to all the integrated applications of the ERP suite [10]. Companies can achieve many cost savings and related benefits from the use of ERP for transaction processing and management reporting through the use of the ERP common database and integrated management reporting tools.

CONCLUSION

The innovative idea of this work is the creation of Intelligent Decision Support System for collaborative network of production enterprises. The Intelligent System is the powerful analytical tool, which enables simulation in order to find the best possible solutions for

manufacturing related processes in the collaboration network of production enterprises. The problems that Intelligent System will be able to solve in the boarders frames of collaboration network:

- The optimal use of resources throw in the conditions of existing constrains.
- The decision support for outsourcing.
- The enabling of information flow between ERP, MRP II and MRP and intelligent system.
- Minimizations of collaboration problems throw decision-making support.

The Intelligent decision system will support the work of different ERP systems of enterprises as one network, which will give big advantages to participating enterprises. It differs from previous proposed by its optimisation ability and decision support, security features and adjustability to particular requirements of collaborative enterprises. Potential customers are collaborative SME-s with or without ERP systems, which are interested in the optimisation of commonly used processes.

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Authors:
M.Sc. Eduard Ševtšenko
Ph.D.Tatyana Karaulova
Prof. Ph.D. Rein Kyttner
Institute of Machinery, Tallinn University of Technology, Ehitajate tee 519086, Tallinn, Estonia
Phone: +372 620 3265
Fax: +372 620 20 20
E-mail: eduard.shevtshenko@ttu.ee tkar@edu.ttu.ee kyttner@edu.ttu.ee